



IMAX[®]
TO THE
ARCTIC

Curriculum Guide for Teachers

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The *TO THE ARCTIC* Curriculum Guide, created by MacGillivray Freeman Films Educational Foundation and Polar Bears International in partnership with Warner Bros. Pictures and IMAX Filmed Entertainment, is appropriate for all intermediate grades (4-8) and most useful when used as a companion to the film, but also valuable as a resource on its own. Teachers are strongly encouraged to adapt activities included in this guide to meet the specific needs of the grades they teach and their students. Activities developed for this guide support National Education Standards for Science, Art, Social Studies, Math, and English.

An extraordinary journey to the top of the world, the documentary adventure *TO THE ARCTIC* tells the ultimate tale of survival. Narrated by Oscar[®] winner Meryl Streep, the film takes audiences on a never-before-experienced journey into the lives of a mother polar bear and her twin seven-month-old cubs as they navigate the changing arctic wilderness they call home. Captivating, adventurous and intimate footage brings moviegoers up close and personal with this family's struggle to survive in a frigid environment of melting ice, immense glaciers, spectacular waterfalls, and majestic snow-bound peaks.

Warner Bros. Pictures and IMAX Filmed Entertainment present a MacGillivray Freeman Film, *TO THE ARCTIC*, a One World One Ocean presentation, directed by two-time Academy Award[®]-nominated filmmaker Greg MacGillivray (*THE LIVING SEA*, *DOLPHINS*). Run time 39 min. To learn more visit: www.imax.com/thotheartctic

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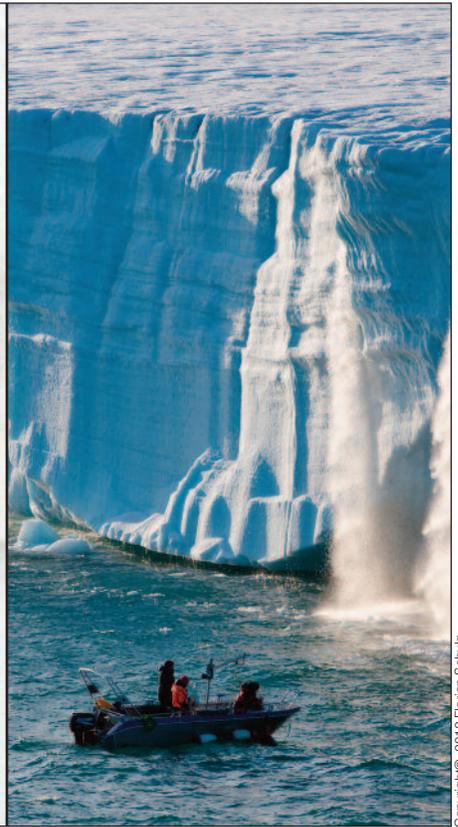
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INTRODUCTION

The picture the Arctic paints in our minds is a wild one: Sweeping expanses of sea ice, towering glacial waterfalls, howling winds, and frigid seas. Polar bears stalk the frozen landscape as herds of caribou migrate across the tundra, headed for ancestral calving grounds. Walrus bask in the icy shallows. The adaptations of these arctic species have enabled them to thrive for millennia in a harsh, unforgiving climate, as severe as it is beautiful. For scientists, film makers, and adventurers alike—this austere region is paradise. Now, the very existence of the arctic ecosystem is threatened by a rapidly warming climate, more drastic here than anywhere else on earth.

The arctic region is more than a geographical distinction. It is a complex, interconnected ecosystem, a distinct climate region, and a mix of cultures, traditions, and native lifestyles dating back to the last ice age. Unlike the Antarctic—a land mass surrounded by ocean—the Arctic consists of a frozen ocean surrounded by several bordering landmasses. This polar ice cap is crucial to the region and currently remains partially frozen year-round. Semi-permanent sea ice plays host to a vast array of life—most notably, the polar bear. A symbol of the Arctic for thousands of years, native peoples have hewn their legends and myths around these iconic animals throughout their history. Today, the polar bear has become



The Arctic is one of the few truly wild places left on the planet. Its majestic environment is exemplified by wildlife and natural beauty unseen anywhere else on earth. Animals such as walrus and polar bear and geographical features like glaciers are symbols of both the Arctic's unique make-up and its changing climate. Photo © Florian Schulz.

the poster child for global warming, putting a face to the worldwide dilemma already threatening this vulnerable species.

130,000 years of evolution have created an animal uniquely suited to the harsh, unforgiving arctic climate. Large claws, fur and papillae (small bumps on the pads of their feet) give the bears traction on the ice, while their characteristic white fur provides camouflage and insulation. Bears in the high Arctic may spend their entire lives on the sea ice—hunting, reproducing, and surviving with no solid ground underfoot. But even for such a well-adapted animal, survival is a task made more formidable by the stress of a disappearing habitat. As the summer ice melts, southern populations of polar bears wander for months without food, stuck on the shores where no seals are to be found.

The polar bear is not the only species whose world is changing.

All across the Arctic, the effects of a warmer summer take hold. Rapidly retreating ice leaves the southernmost areas of the Arctic Circle bare of ice for months at a time. The summer of 2007 found the lowest sea-ice extent on record, reduced by over a third in only twenty-five years. Caribou, another well-known species of the Arctic, migrate thousands of miles each year to calve on the rich slopes of Alaska. The journey, already long and difficult, is made harder by swarms of insects brought on by the earlier onset of summer.

The Arctic is often called a “canary in a coal mine” for the planet, as the drastic changes taking place there are indicators of what is likely to come in the rest of the world. But climate change is not inevitable. Behavioral changes made



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Caribou herds migrate to the North Slope of Alaska at the end of every winter, participating in one of the largest migrations on Earth. For ten thousand years, caribou have traveled here to give birth to their calves.

today will decide what happens tomorrow in the Arctic and in our own backyards.

Polar bears, caribou, and walrus; icebergs, waterfalls, and winds: each is a part of a unique ecosystem. With the IMAX film *TO THE ARCTIC* as background, students will use this course as a window into an icier world, gaining a greater understanding of the unique diversity and harsh reality of a changing Arctic. Only by taking action now can we make a difference in the future.

Welcome to the Arctic.

TOP OF THE WORLD— A GEOGRAPHY LESSON



OBJECTIVE

Students will identify, outline, and map the Arctic Circle, including the countries that lie within its boundaries. Students will define the arctic region by latitude, temperature, and tree line. Students will compare and contrast the human and environmental characteristics of the North and South Poles, the equator, and their home town.

IN THE FILM

TO THE ARCTIC provides a bird's eye view of a complex region of land, animals, and cultures. It's viewers soar over the vast landscape as they explore glaciers, tundra, sea ice, and ocean. Occupying this unique habitat we find caribou herds, wandering polar bears, walruses, and birds. While the harsh environment of the Arctic often brings with it average daily temperatures of minus 30 degrees Fahrenheit, the vast expanses of glaciers and oceans are being impacted by climate change.

MATERIALS

For Activity 1:

- ☐ Arctic Map handout (pg. 6, one per student)
- ☐ Large world map
- ☐ Globe
- ☐ Colored pencils, markers, or crayons
- ☐ Pencils and erasers

For Activity 2:

- ☐ 66 Degrees and Me! handout (pg. 7)
- ☐ Local Newspapers
- ☐ Computers with Internet Access
- ☐ Almanac (optional)
- ☐ World map
- ☐ Globe
- ☐ Pencils and erasers

TEACHER PREP NOTES

This lesson contains two activities. Timing for activities will take 1-2 hours total. Students will benefit from having an Arctic Notebook or folder for this unit for storing maps, activities, notes, ongoing vocabulary and assessments. For Activity 1, print teacher and student copies of the Arctic Map handout. For Activity 2, print **66 Degrees and Me!** handout for students. As a resource, visit: [//polardiscovery.who.edu/arctic/geography-en.html](http://polardiscovery.who.edu/arctic/geography-en.html) to see a map of the Arctic Circle as defined by latitude, temperature, and tree line.

BACKGROUND

The Arctic is a vast and surprisingly diverse region of land and ice. The Arctic Circle is an imaginary line of latitude located at 66 degrees 33 minutes (66°33' above the equator). The following countries exist within the Arctic Circle: United States (Alaska), Russia, Canada, Norway, Sweden, Finland, Iceland and Greenland (Denmark). In the Arctic Circle, the sun never sets on the summer solstice (June 21) nor rises on the winter solstice (December 21). The average temperature of the warmest month (July) in the Arctic is below 50°F (10°C), and the arctic tree line is the northern limit of stands of trees on land. Above this line of latitude, trees do not grow. There are many misconceptions about the Arctic, especially when compared to Antarctica. For example, polar bears and penguins do not live in the same regions; polar bears live in the Arctic only, while penguin species are found in Antarctica, South Africa, and South America.

Key Words

Arctic: The northernmost polar region. The arctic region consists of the Arctic Ocean surrounded by treeless permafrost.

Arctic Circle: The Arctic Circle is an imaginary line of latitude located at 66 degrees 33 minutes (66°33' above the equator). Here the sun never sets on the summer solstice (June 21) nor rises on the winter solstice (December 21).

Antarctica: Earth's southernmost continent, encapsulating the South Pole.

Isotherm: A type of contour line that connects points of equal temperature.

Permafrost: Ground that is permanently frozen, often to great depths, the surface sometimes thawing in the summer.

Tundra: A cold, treeless area between the arctic sea ice and the tree line. The lower layers of soil are permanently frozen, but in summer the top layer of soil thaws and can support low-growing mosses, lichens, grasses, and small shrubs.

ACTIVITY 1: MAPPING THE ARCTIC

To Do

- 1** Ask students what they know about the Arctic and record their ideas on poster paper to reference later. Encourage all students to respond whether or not they are certain of their answers.
- 2** On a classroom map of the world, ask a student to locate the Arctic. Meanwhile, ask another student to locate the Arctic on a globe. Compare and contrast these two views. As a class, discuss which view (map or globe) shows the arctic region in a format that is easier to see.
- 3** Discuss each definition of the Arctic (by latitude, temperature, and tree line) using a large classroom



map of the world or a globe; discuss longitude and latitude as needed.

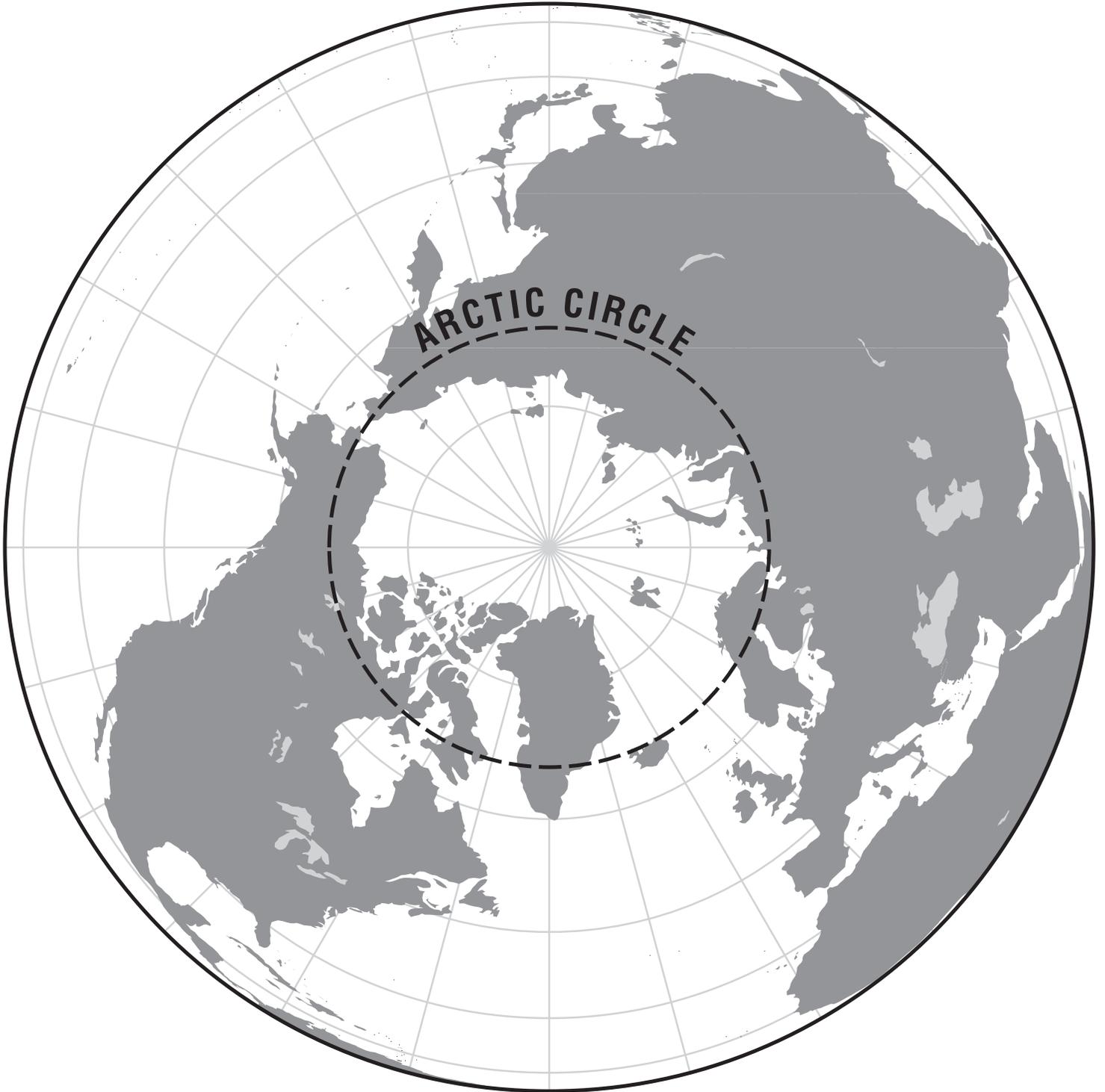
- 4** Have students copy all three definitions on lined paper to keep in their Arctic folder.
- 5** Emphasize that the Arctic is a “region” consisting of seven countries and is a unique and harsh habitat that people, plants, and animals call home.
- 6** Pass out the **Arctic Map** handouts.
- 7** As a class, locate each country that lies within the Arctic Circle.
- 8** Have students label the following countries on their Arctic Circle maps: Norway, Finland, Sweden, Russia, Iceland, Greenland (Denmark), United States (Alaska), and Canada.
- 9** Trace the Arctic Circle (66 degrees latitude) using colored pencils, markers, or crayons.
- 10** Return to the students’ ideas of the Arctic. Confirm correct ideas and change incorrect ideas. Leave unanswered ideas from this lesson to address later and tell students that they will continue to learn more about the Arctic in the following lessons.

ACTIVITY 2: 66 DEGREES AND ME!

To Do

- 1** Ask students to think about the area around them. What natural features surround them? What is the weather outside? What did they have for breakfast and what will they have for lunch and dinner?
- 2** Have students complete the **66 Degrees and Me!** table in pairs or small groups.
- 3** Compare and contrast as a class what they discovered about the Arctic through their comparison of their home town and the other countries. How is the Arctic the same? How is it different? How does the environment affect the people who live there?

Arctic Map



66 Degrees and Me!

	Svalbard, Norway	McMurdo Base, Antarctica	Quito, Ecuador (South America)	My town:
Latitude:	74-81 N latitude	72 S latitude	0 S latitude	
Longitude:	10-35 E longitude	116 W longitude	78 W longitude	
Average January low/high temperature	Low: -20C/-4F High: -13C/10F	Low: -5C/22.1F High: -0.2C/31.6F	Low: 10C/50F High: 18.8C/66F	
Average July low/high temperature	Low: 4C/39F High: 6C/43F	Low: -30.1C/-22F High: -21C/-7.1F	Low: 9.4C/49F High: 19.4C/67F	
Average January hours of sunlight	0	24	12	
Average July hours of sunlight	24	0	12	
Typical breakfast, lunch, and dinner menu	B: bread, butter, jam, meats, milk L: sandwiches, milk D: fish, meatballs, potatoes, milk	Scientists bring their own food from their own country of origin. Most is canned, freeze-dried or frozen.	B: stuffed bread or pastry L: biggest meal of the day: stews, rice, avocados D: meat stews, rice, beans	
What I would wear to school in September	Winter coat, hat, and gloves	There are no schools in Antarctica but students do visit to study the region. Every part of the body is layered, covered and protected from the elements.	Light shirts, pants, skirts or dresses. Only a light jacket or sweater.	
What I would wear in July	Lots of layers including hats, gloves and winter coats and boots	Same as January!	Shorts, t-shirts, sundresses and sandals. Perhaps a light jacket or sweater in the evening.	
Wild animals in my state or province	Polar bears, foxes, caribou (reindeer), whales, walruses, seals, fish, sea birds	There are no land animals but you will see sea mammals, penguins and other sea birds.	Ocelots (a wild cat), lizards, giant tortoise, exotic birds, butterflies, deer	
When I look out the window, I see...	Oceans and mountains and snow covered peaks	Ocean, snow and ice covered land, mountains	A big city with a volcano, lots of parks, trees, buildings, lots of people	

EXTREME ECOSYSTEMS— A BIODIVERSITY LESSON



OBJECTIVE

Students will identify and categorize plants and animals in the Arctic with an emphasis on which animals are endangered, threatened, or a species of special concern. Students will participate in individual species studies, presentations, and an interactive class trivia game. They will gain a deeper understanding of the biodiversity in the Arctic and their own role in helping to protect the Arctic's unique inhabitants. Included topics of study are the indigenous peoples of the Arctic who rely heavily on various species in their ecosystem for food, clothing, and building materials.

IN THE FILM

In *TO THE ARCTIC*, viewers are exposed to the biodiversity of the arctic region and the interdependence of species in a complex ecosystem. Caribou feast on cotton grass, polar bears hunt ringed seals, and Inuit guides provide researchers with valuable knowledge about the terrain and animals that live there.

MATERIALS

For Activity 1:

- Arctic Inhabitants Table handout (pg. 10)
- Computers with Internet access
- Encyclopedia access (books, CDs, Internet)
- Poster paper
- Index cards
- Notes/facts from species report

TEACHER PREP NOTES

Print the **Arctic Inhabitants Table** handout. Use one of the tables to cut into pieces for students to pick randomly. Make sure all categories are represented to ensure that students understand the concept of interconnectedness in the Arctic ecosystem.

BACKGROUND

Arctic species have developed special adaptations to survive in their harsh environment. The arctic food web is made up of fewer species and is more fragile than those in other regions of the world. A smaller food web makes it more sensitive to disruptions—the decline or extinction of a single species will impact the ecosystem as a whole, because each species depends on another for survival. Interconnectedness of these species supports the biodiversity of this region.

Non-living elements of the arctic environment, such as sea ice, are also necessary. At the top of the food chain, the polar bear requires sea ice to hunt its primary food source, the ringed seal, which—along

with the walrus—uses the sea ice for its birthing grounds. The arctic fox trails closely behind polar bears to scavenge the remains of seals, and gulls fly in to compete for what might be left in this dynamic food web. Without sea ice, none of these species would survive.

ACTIVITY 1: SPECIES REPORTS

To Do

- 1** As a class, define and discuss the terms: Endangered, Threatened, and Species of Concern. Add the definitions to a class poster (as students conduct their presentations, list their animal of study in the appropriate category).
- 2** Have each student draw the name of an arctic inhabitant from a hat. After researching their species, have them create a short Power Point or poster board presentation for the rest of the class (have students work in pairs or small groups as an option).
- 3** Use the following guidelines for presentation content:
 - Common and scientific name/other names (given by Native Peoples)
 - Category (land/ marine mammal, bird, fish, invertebrate, plant)
 - Scientific picture of the species
 - Physical adaptations that allow it to survive in the Arctic
 - Habitat (specific geographical location)
 - Diet (if animal)
 - On whom or what does it depend in the ecosystem?

Key Words

Threatened: Any species likely to become endangered in the foreseeable future within all or a significant part of its range. Threatened species are less protected than endangered species, but are monitored for changes in population.

Endangered: A species found in such small numbers in its natural environment that it is in high danger of becoming extinct in the near future due to natural or man-made changes.

Special Concern: Species declining in population or range at a rate that could lead to being listed as endangered or threatened under the Endangered Species Act.

Biodiversity: The degree of variation of life forms within a given ecosystem, biome, or an entire planet. Biodiversity is a measure of the health of ecosystems and is in part a function of climate. For example, tropical regions are typically rich whereas polar regions support fewer species.

Ecosystem: A biological environment consisting of all the organisms living in a particular area along with all nonliving components of the environment, such as air, soil, water and sunlight.

Adaptation: A physical attribute an organism has that helps it survive in its habitat.

Food Web: Depicts feeding connections (what eats what) in an ecological community.

Sea Ice: Formed from sea water that freezes. Sea ice supports the species within the arctic ecosystem.

- What or who depends on it in the ecosystem?
(Example: What eats me?)
- Threatened? Endangered? Special Concern?
(If so, why? Who/what is affecting this species?)
- Fun Facts

TAKING IT FURTHER:

Discuss how the arctic ecosystem might be affected if one species was removed from it and what might happen if a new species was introduced. What are current threats to the species (natural and human-caused)? Which scientists study the species? What

are the findings of their research? How are the findings impacting the arctic ecosystem and species management? Discuss examples of your community/regional ecosystem.

Which species is threatened/endangered/special concern in your community? Who/what is affecting this species? How can you help? What are others are doing to help?

How is the changing climate affecting this species? How do your actions influence your ecosystem/arctic ecosystem?

Arctic Inhabitants Table

Mammals	Other Animals	Plants	Indigenous Peoples
<i>Land</i>	<i>Birds</i>	Arctic Moss	Inuit
Caribou	Ivory Gull	Arctic Willow	Inupiat
Snowshoe Hare	Arctic Tern	Caribou Moss	Sami
Arctic Fox	Snowy Owl	Bearberry	Athabaskan
Moose	Arctic Goose	Tufted Saxifrage	Koryak
<i>Marine</i>	Ptarmigan	Labrador Tea	Yu'pik
Polar Bear	<i>Fish</i>	Cotton Grass	Chukchi
Bowhead Whale	Greenland Shark	Kelp	Gwichin
Bearded Seal	Arctic Cod	Ice Algae	
Ringed Seal	Whitefish	Phytoplankton	
Harp Seal	<i>Invertebrates</i>		
Humpback Whale	Krill		
Narwhal	Copepod		
Beluga	Mollusk		
Walrus	Nose-bot Fly		
	Warble Fly		
	Mosquito		

TEACHER: CUT ON DASHED LINE FOR TWO HANDOUTS FROM THIS SHEET.

Arctic Inhabitants Table

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Bowhead Whale	Greenland Shark	Kelp	Gwichin
Bearded Seal	Arctic Cod	Ice Algae	
Ringed Seal	Whitefish	Phytoplankton	
Harp Seal	<i>Invertebrates</i>		
Humpback Whale	Krill		
Narwhal	Copepod		
Beluga	Mollusk		
Walrus	Nose-bot Fly		
	Warble Fly		
	Mosquito		

CARIBOU ON THE MOVE! — A MIGRATION LESSON



OBJECTIVE:

Students will study the migration route, home range, and migration challenges of the Porcupine caribou herd through a migration game and a Google Earth tour.

IN THE FILM

As seen in *TO THE ARCTIC*, the Porcupine caribou herd is observed during their annual migration north to their summer birthing grounds. The Porcupine caribou make it to their calving grounds on the coastal plain of the Arctic National Wildlife Refuge to take advantage of the rich cotton grass and protected habitat before giving birth. Flooding rivers and thawing terrain make this journey more difficult each year as the climate warms. In the future, caribou may be faced with migration challenges as their range is fragmented by human development and the impacts of climate change.

MATERIALS

Materials for Migration game (as listed on Project Caribou website):

- Large outdoor space
- Computer(s) with Internet access
- Student and teacher copy of **Arctic Map** handout (pg. 6)

Teacher Prep Notes

This lesson contains several activities. Timing for all activities will be approximately 2 hours. For the game outline, visit www.projectcaribou.net. From the Activity List, download the ‘Barren-ground caribou migration’ game for directions. Depending on time and resources, the tour activity can be done as a class, in groups, or individually. Try the Google Earth tour in advance to familiarize yourself and to ensure the application is working properly. The tour will have pictures and information embedded and will highlight the locations of the caribou in the film. There will be stopping points on the tour that are highlighted in the following lesson. Download the student and teacher copy of the Arctic map if using the low technology option.

BACKGROUND

Caribou are adapted to fill a specific role, or niche, in the arctic food web. They eat grasses, mosses, lichens, fungi, and twigs and leaves of birches and willows, and are preyed upon by wolves. The majority of the world’s caribou are concentrated in northern Canada and Alaska, which is home to the Porcupine caribou—one of the largest herds in the world, numbering 123,000-125,000 and ranging over 96,000 square miles

(260,000 square kilometers). While their summer and winter ranges are only about 400 miles apart, satellite tracking shows they don’t always migrate in a straight line, sometimes traveling up to 4,000 miles between their summer and winter ranges in Alaska and Canada, respectively.

Female caribou migrate to the north slope of Alaska in spring to give birth in “calving grounds.” Calving grounds provide protection and relief from predators and insects, and the supply of highly nutritious cotton grass on the coastal plain provides them with enough food to sustain their journey south in fall.

Caribou have been and remain culturally important to the indigenous communities on both sides of the Alaska/Yukon border, including those of the Gwich’in, Inupiat, and Inuvialuit. They have depended on caribou for thousands of years for food, clothing, and a way of life that relates closely to the land.

Unfortunately, the Porcupine caribou could soon face challenges of habitat fragmentation if oil development is sanctioned in the Arctic National Wildlife Refuge. In addition, the changes in climate already impacting each aspect of the arctic ecosystem will also significantly impact the caribou’s future. For example changing weather patterns will alter the snow pack, which will affect the level of the rivers at any given time, as well as altering the growth of cotton grass—all of which will impact the caribou’s ability to survive their long migration.

ACTIVITY 1: PROJECT CARIBOU MIGRATION GAME

Project Caribou Website (www.projectcaribou.net).

ACTIVITY 2: TRACKING THE PORCUPINE CARIBOU MIGRATION

To Do

- 1 Lead a discussion on the caribou migration seen in the film. Using a map of the U.S and Canada, ask your students to identify the route of the Porcupine caribou herd migration to demonstrate its geographical range.

Key Words

Niche: The role an organism has in its ecosystem.
Porcupine Caribou Herd: The caribou herd found in Alaska and Canada, named after the Porcupine River that runs through the herd’s range.
Migration: Relatively long distance movement of a species on a seasonal basis. The trigger for the migration may be local climate, availability of food, the season of the year, or mating purposes
Indigenous: Original inhabitants of a territory
Climate Change: Long-term change in average weather conditions



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A caribou herd crosses Kukpuk River in Northwestern Alaska, one of dozens of rivers caribou may swim on their epic migration to the calving grounds. If caribou mothers give birth on the hoof during the migration, their calves must immediately begin fording rivers and crossing mountains with the rest of the herd.

Technology Option: *Google Earth Virtual Tour—* Download Google Earth: <http://earth.google.com>. Download the .kmz file: www.macgillivrayfreeman-films.com/arctic/Google_Earth_Tour_Porcupine_Caribou_Migration.zip

- 1 Tell your students they will be traveling with the Porcupine caribou herd on their annual migration through a Google Earth Virtual Tour. Have students work independently or divide them into groups if you choose not to work as a class, then instruct them on the basic operations of the Google Earth program.
- 2 Begin the tour at the herd’s wintering grounds. Follow the migration as seen in the film, guide students (if working as a class), or ask students to stop at each point along the tour.
- 3 Guiding Questions: What did the students learn from the migration of the Porcupine herd? Review, why do caribou migrate? What challenges do caribou face during migration? What are the consequences the caribou face if they give birth to their young before reaching their summer calving grounds?
- 4 Have students write a short response to the following two questions: How do human actions affect caribou migration? And what can we do to help the caribou?

Low-Technology Option: *Map the Migration*

- 1 Place a copy of the Arctic Map handout (pg. 6) on an overhead projector.
- 2 Have students plot the Porcupine herd’s winter range, coloring in the herd’s winter area in blue and using your map as a guide.
- 3 Have students plot the herd’s summer range by coloring in the herd’s summer area in red.
- 4 Connect the two ranges with a green line indicating the route of their migration.
- 5 Use the guided questions above, and writing assignment for wrap up.

*For more routes of collared caribou, visit the website www.taiga.net/index.html.

TAKING IT FURTHER

What can we do as a community to support wildlife, their habitats, and migration corridors in the Arctic? Learn more about the Arctic National Wildlife Refuge, and the balance between preservation of land and extraction of natural resources, such as oil development on the North Slope of Alaska. Our actions impact these beautiful lands and species that live there. How will you affect positive change?

MOM AND ME: A POLAR BEAR SURVIVAL STORY



OBJECTIVE:

Students will learn about the connection between mother polar bears and cubs through an interactive exploration of the Polar Bears International website. Students will also discover the connection between polar bear survival and sea ice. They will analyze this connection through a graph analysis activity, comparing two graphs—one showing female polar bear weights and the other showing sea ice coverage.

IN THE FILM

TO THE ARCTIC follows a mother polar bear and her two cubs as they face the challenges present in a harsh and rapidly changing habitat. Moms and cubs need all the food they can get before the sea ice retreats, taking the ringed seals with it. In a good year, their fat stores can sustain them throughout the long summer, but as the summer sea ice retreats further each year due to global climate change, they're often unable to find enough food.

MATERIALS

For Activity 1:

- Copies of **Mom and Me: A Polar Bear Crossword Puzzle** handout (pg. 15)
- Computers with Internet access (or copies of Mini-Posters)
- Pencils and erasers

For Activity 2:

- Copies of Sea Ice **Break-up Dates, Lone Female Body Mass Graphs** handout (pg. 16)
- Copies of **Polar Bear Eco-Regions Map** (optional, pg. 19)

TEACHER PREP NOTES

By reading the background information, students should recognize the connection between polar bear survival and sea ice. This lesson contains two activities. Print the **Mom and Me: A Polar Bear Crossword Puzzle** handout and download the Mini-Posters from the Polar Bears International (PBI) website: www.polarbearsinternational.org/education/educational-tools-and-materials. Also print the **Break-up Dates, Lone Female Body Mass Graphs** handout and the **Polar Bear Eco-Regions Map** handout. Familiarize yourself with the PBI website addresses identified in the lesson. Use the questions listed in Activity 2 to create a worksheet for students to analyze the graphs.

KEY WORDS

Addressed in **Mom and Me: A Polar Bear Crossword Puzzle**

BACKGROUND

Female polar bears prepare to raise their young long before they give birth. Mating takes place on the ice in April or May, but the fertilized egg will not implant in the female's uterus (delayed implantation) until early fall, after she has gained sufficient weight for a successful pregnancy. This delay gives her time to fatten up on seal blubber. Females often gain more than 400 lbs. during their short hunting season, allowing them to fast for up to eight months.

Female polar bears enter their maternity dens by mid-to late October and give birth between November and January. They spend the next few months nursing their cubs up to six times a day and remain in their dens through March or April to protect their cubs from the coldest temperatures of winter. Newborns are 12 to 14 inches long (30–35 cm) and weigh little more than one pound (0.5 kg), but grow rapidly from their mother's rich, 33%-fat milk. When the family group finally emerges from its den, the mother stays nearby until her cubs develop the strength to walk long distances. Mothers can then break their long fast and lead their cubs onto the ice to hunt seals.

Solid food comes when cubs are three or four months old and the mother makes her first kill of the spring. Ringed seals—the primary food source of the polar bear—rest at breathing holes, cracks, or on the surface of the ice. The mother's success at hunting is both critical for her own needs and for modeling the hunting behavior her cubs will need to learn to find food for themselves. As long as there is sea ice, these areas are also accessible to the polar bears.

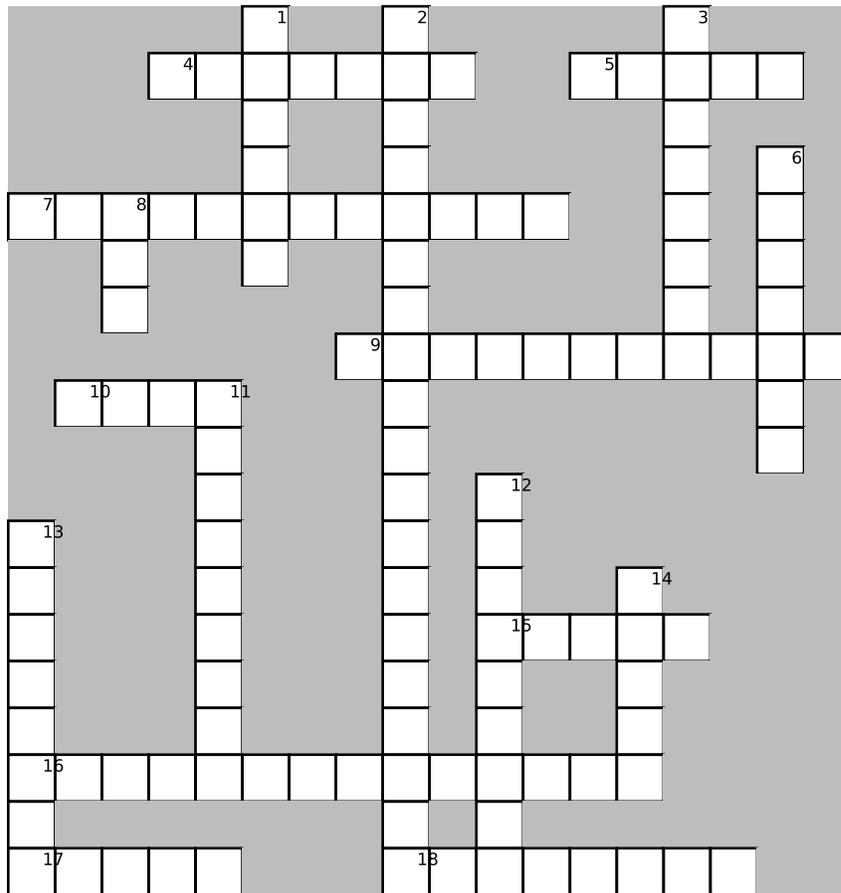
Although there has always been loss of sea ice during the warmest months of the year, the current overall decrease in sea ice and the early break up and later freeze up is translating into a longer fasting period for polar bears. Less time on the ice to hunt will lead to the inability of females bears to gain ample weight for successful pregnancies, thus prohibiting the species' ability to sustain itself.

ACTIVITY 1: POLAR BEAR FACTS SCAVENGER HUNT & CROSSWORD PUZZLE

To Do

- 1 Have students watch the *All about Polar Bears* PowerPoint appropriate to their grade level for an engaging introduction to the polar bear world. www.polarbearsinternational.org/education/educational-tools-and-materials.

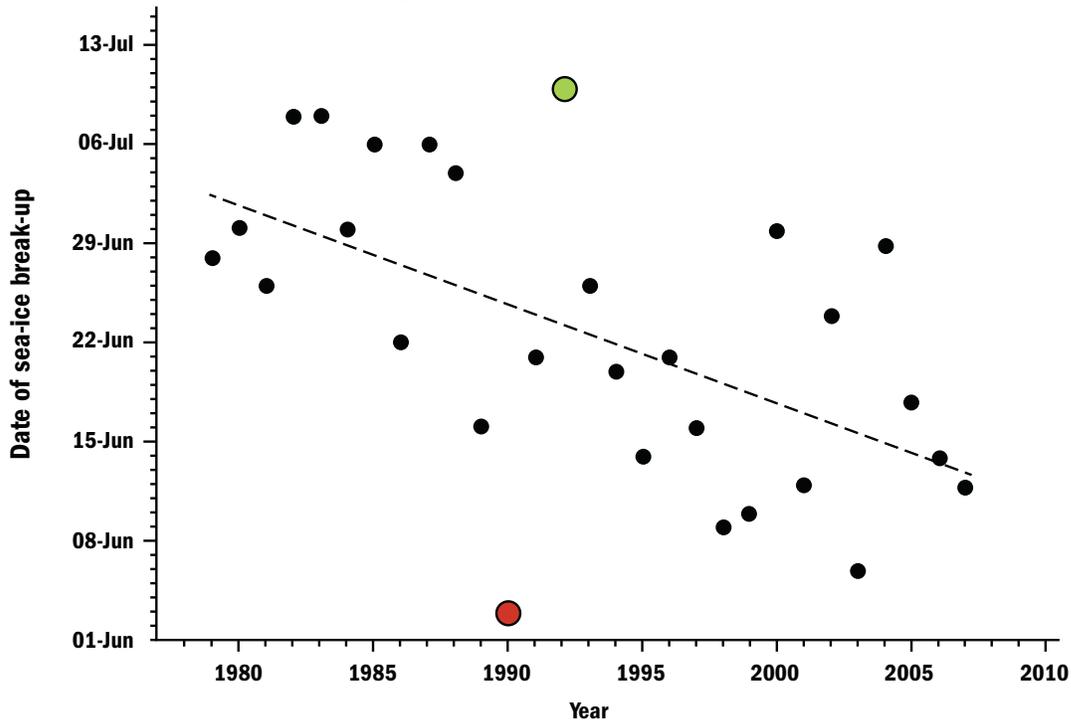
Mom and Me: A Polar Bear Crossword Puzzle



- Across
- 4 Polar bears do not have this, but they eat it.
 - 5 The color of a polar bear's skin.
 - 7 A snow cave where cubs are born. (2 Words)
 - 9 Polar bears' favorite food. (2 Words)
 - 10 What cubs are called.
 - 15 Number of months a female polar bear stays in the den to give birth.
 - 16 The species name for 'polar bear'. (2 Words)
 - 17 A zoo bear that lived to be 42 years old!
 - 18 Number of different bear populations in the Arctic.

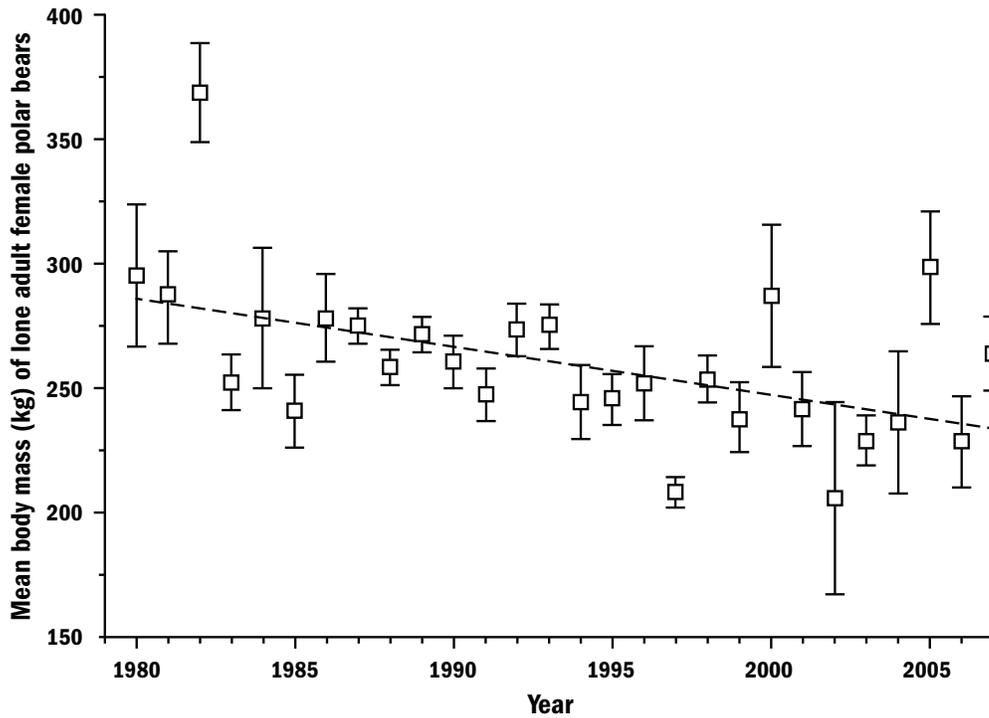
- Down
- 1 The polar bear's only enemy.
 - 2 Used in reproduction to time the birth of cubs during the most favorable conditions for survival. (2 Words)
 - 3 Small bumps that keep polar bears from slipping on ice.
 - 6 A flat sheet of ice floating in the sea. (2 Words)
 - 8 Number of cubs a polar bear mom typically has per birth.
 - 11 What a polar bear is called after it leaves its mother between the age of 2 to 2 1/2 years old.
 - 12 What the period of time a female polar bear is pregnant is called.
 - 13 The weight of a newborn cub. (2 Words)
 - 14 Openings in the sea ice.

Sea Ice Break-up Dates 1979-2007



Date of break-up of the sea ice used by the Western Hudson Bay polar bear population from 1979-2007. (from Stirling and Lunn 1999, Stirling and Lunn unpublished data).

Lone Female Polar Bear Body Mass, 1980-2007



Mean estimated mass of lone (and thus likely pregnant) adult female polar bears in the fall in Western Hudson Bay from 1980 through 2004 (dashed line indicates fit of linear regression) (from Stirling and Parkinson 2006. *Arctic* 59:261-275)

POLAR BEARS IN A WARMING WORLD—A CLIMATE CHANGE LESSON



OBJECTIVE:

Students will locate and distinguish the four major sea ice eco-regions in the Arctic and explore the impacts of sea ice loss over time due to climate change and the ensuing threats these changes may have on the arctic ecosystem and its inhabitants.

IN THE FILM

Over the past few decades, Arctic sea ice has retreated dramatically due to global climate change. Sea ice loss creates survival challenges for the humans and wildlife that depend on the Arctic sea ice ecosystem, including polar bears. As seen in *TO THE ARCTIC*, waterfalls and thinning sea ice provide a startling backdrop as the effects of climate change takes its toll on Arctic life.

MATERIALS

For Activity 1:

- Computer with Internet access
- *Polar Bears in a Warming World* PowerPoint found at polarbearsinternational.org/education/educational-tools-and-materials
- Projector

For Activity 2:

- **Polar Bear Eco-Regions Map** (Pg. 19, one per student)
- Computer(s) with Internet access
Steve Amstrup—Four Ice Eco-regions video: youtube.com/watch?v=HtYI6HF7JIE&NR=1.
- Arctic maps
- Projector

TEACHER PREP NOTES:

Print the *Polar Bears in a Warming World* PowerPoint from polarbearsinternational.org/education/educational-tools-and-materials. Familiarize yourself with the four Ice Eco-regions video ahead of time at youtube.com/watch?v=HtYI6HF7JIE&NR=1.

BACKGROUND:

Since the early 1980's, observations have recorded a steady decline in sea ice in the Arctic. This is due to a warming trend that scientists have linked to a build-up of greenhouse gases in the atmosphere. Arctic sea ice now forms more slowly in winter and melts faster in summer. Scientists are studying the reasons behind the sea ice loss and the impact it has had and will continue to have on biodiversity in the Arctic and on global climate. The thinning sea ice affects the reflectivity of the sun's

energy back into the atmosphere, called the albedo effect. With abundant sea ice coverage, much of the sun's energy is reflected back to space, but with increasing amounts of open water, more and more of the sun's energy is absorbed. Loss of sea ice leads to increased absorption of the sun's energy and further warming of our climate.

Loss of sea ice has impacts on the entire arctic ecosystem. In the film we see the challenges the polar bear faces with thinning sea ice. Loss of sea ice affects where and how polar bears

hunt, breed, and, in some cases, den. Changes in their distribution or numbers affect the entire arctic ecosystem. Global climate change affects humans as well, both in the Arctic and throughout the rest of the world. Scientists believe that if we take action now, we can reduce, slow down, and stabilize greenhouse gases in sufficient quantity to save the sea ice and therefore the arctic ecosystem that depends on the ice.

ACTIVITY 1: POLAR BEARS IN A WARMING WORLD To Do

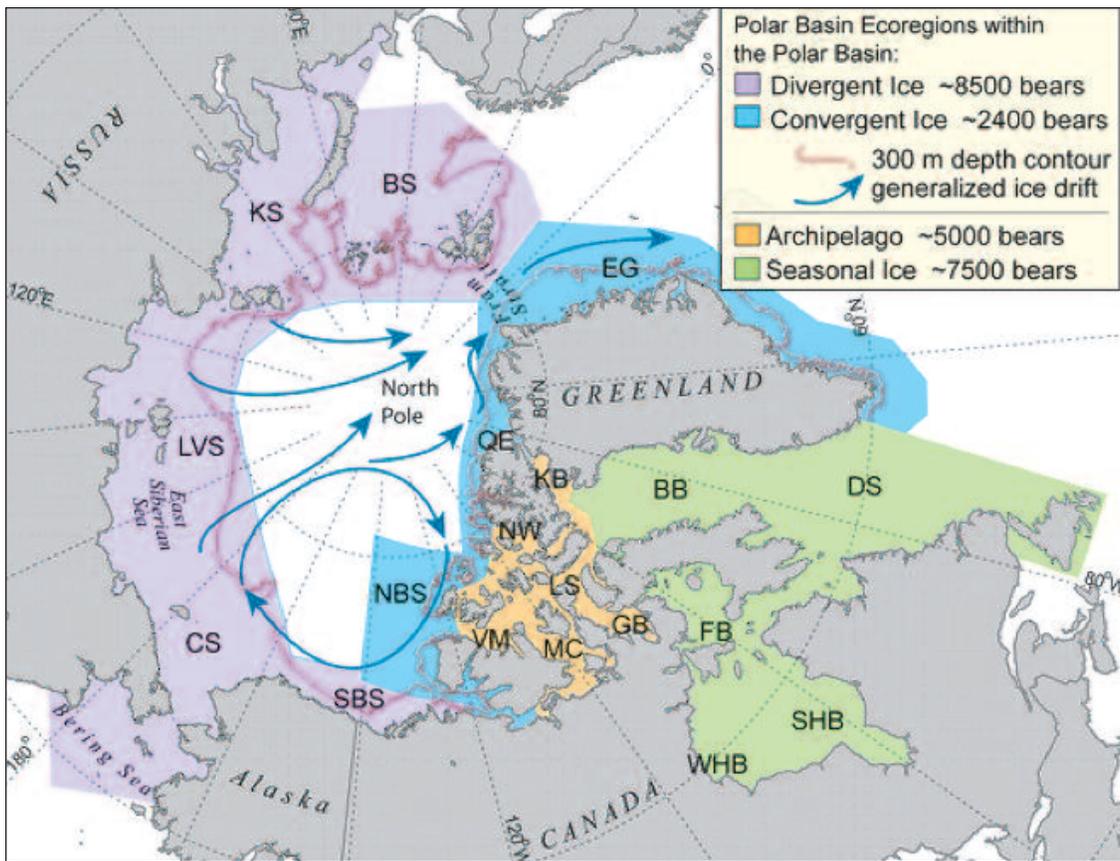
- 1 Watch *Polar Bears in a Warming World* PowerPoint as a class. This PowerPoint gives an overview of climate change, sea ice coverage in the arctic and impact on polar bears.

ACTIVITY 2: ARCTIC SEA ICE MAPPING ACTIVITY To Do

- 1 Scientists have identified four different sea ice eco-regions in the Arctic. Place the sea ice eco-region diagram on an overhead and have a copy available for each student.
- 2 Have students watch the video: *Steve Amstrup—Four Ice Eco-regions*. Dr. Steven C. Amstrup, a leading polar bear scientist introduces the four major ice eco-regions.
- 3 Have students correlate the seasonal ice map with their Arctic maps. Students can place each of the types of seasonal ice on their maps with four distinct colors.
- 4 After looking at the four types of ice eco-regions, have students examine decline of sea ice coverage

Key Words

Sea ice: Formed from sea water that freezes. Sea ice supports the species within the Arctic ecosystem.
Sea ice Eco-regions: Defined by how the sea ice forms and changes within each area and how this affects polar bears. There are four main eco-regions.
Climate: Average weather conditions.
Albedo effect: Strength of reflection of the sun off the surface of the ocean water or sea ice.
Climate change: Long-term change in average weather conditions.



Nature, December 2010

over time. Students can compare and contrast over several decades and see ice coverage extent between winter and summer months on the following website link:

windows2universe.org/earth/polar/sea_ice/sea_ice_compare.html

- 5 Now that students have observed the impact of decreasing sea ice coverage and impact on polar bear populations, have them brainstorm about how decline in sea ice impacts other organisms in the Arctic. How will this affect other animals featured in *TO THE ARCTIC*? How will a decline of sea ice coverage impact people who live in the Arctic and subarctic?

Seasonal Ice Eco-region—Seasonal ice areas occur at the southern extreme of the polar bear’s range and include places like Canada’s Hudson Bay, where the ice melts each summer and the bears must wait for freeze-up in the fall until they can hunt again. Polar bears in these seasonal areas are the most endangered, with longer and longer ice-free seasons testing the limits of their fat reserves.

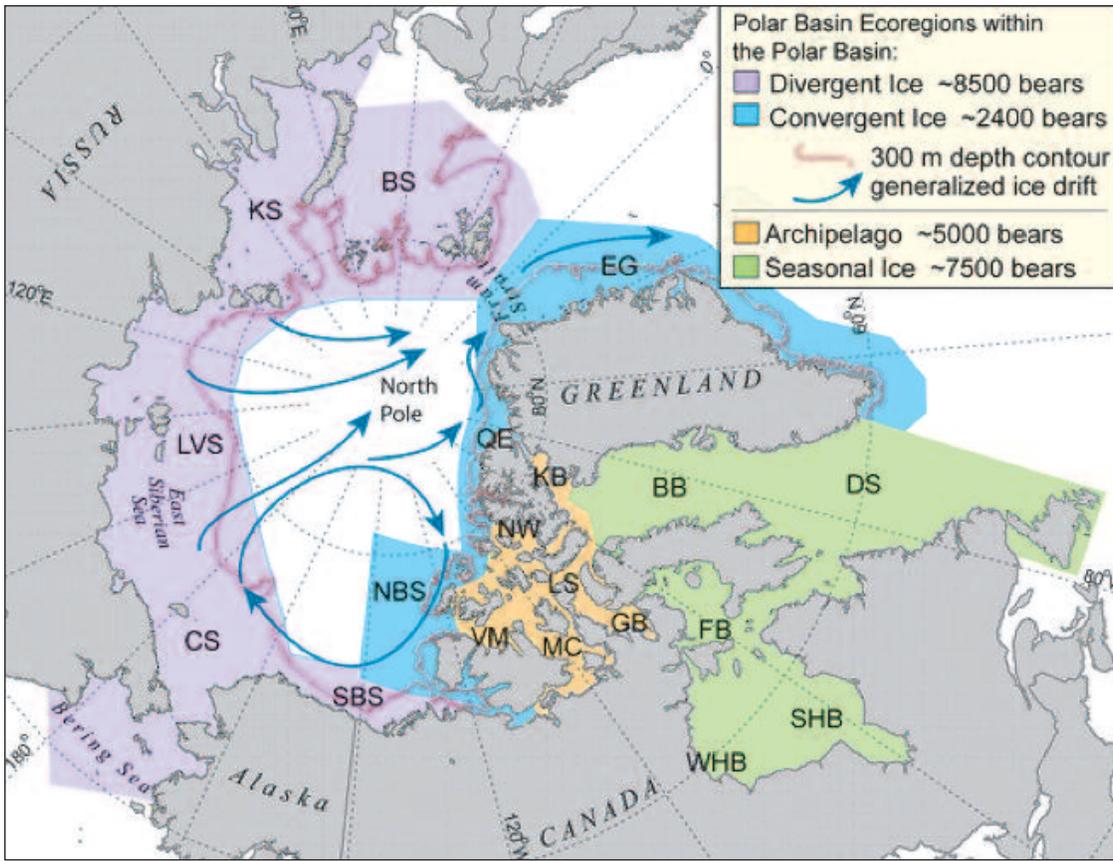
Polar Basin Divergent Ice Eco-region—In these areas, sea ice forms along the shore but then retreats, especially in summer. As the sea retreats farther and farther from shore in a warming Arctic, these polar

bears are faced with a choice of coming ashore—fasting until the ice returns in the fall—or swimming long, exhausting distances to reach the remaining pack ice. Ice located far offshore, however, often covers unproductive parts of the sea, so bears in these areas may successfully complete a marathon swim but still not find any seals to hunt. Polar bears that live in these areas are at great risk: From longer and longer swims, prolonged fasting periods, or encounters with humans on shore.

Polar Basin Convergent Ice Eco-region—Sea ice formed in other parts of the Arctic collects along the shore of these habitats, providing polar bears with access to seals. Polar bears in these areas are faring well now, but scientists predict that ice in these areas will disappear within 75 years—and, with it, resident polar bear populations—unless action is taken to reduce CO₂.

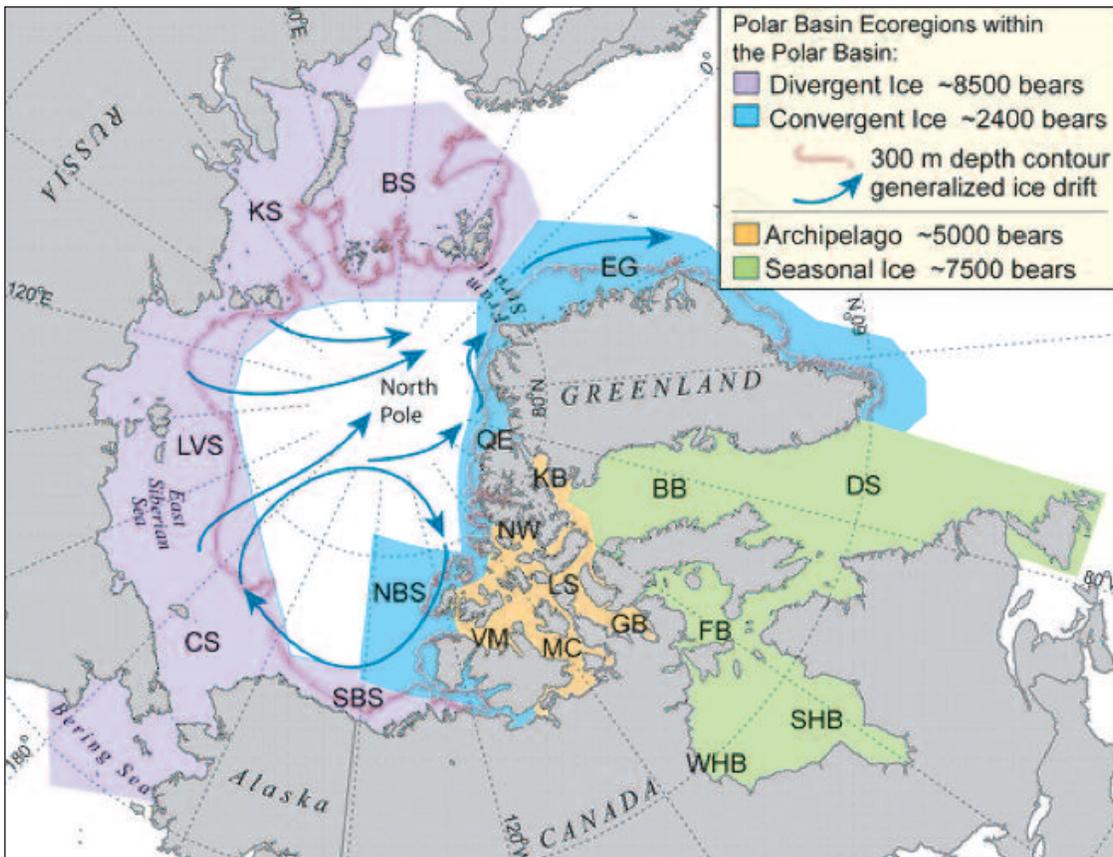
Archipelago Ice Eco-region—Islands in the Canadian High Arctic and Greenland are far enough north that sea ice remains along the coast even in summer, providing hunting for the bears. This eco-region is predicted to be the last stronghold for polar bears, but it, too, is expected to melt within 100 years unless greenhouse gas emissions are greatly reduced.

Polar Bear Eco-Regions Map



TEACHER: CUT ON DASHED LINE FOR TWO HANDOUTS FROM THIS SHEET.

Polar Bear Eco-Regions Map



TAKING ACTION!



OBJECTIVE

Students will gain an understanding of the impact of greenhouse gases on the environment. With this knowledge, they will create an action plan of conservation behaviors to help them connect their choices with reducing greenhouse gases and reducing harm on the environment.

IN THE FILM

As seen in *TO THE ARCTIC*, arctic habitat is being affected by the warming temperature of our world. What you and I do thousands of miles away has an impact on the arctic habitat. Although climate change has greatly affected the polar bear's sea ice habitat, scientists emphasize that it isn't too late to take action on this issue—and each of us can help: at home, work, school, and in our communities. The warming of the Arctic affects us all directly. Ocean currents flow from the Arctic and cool the entire planet. If ocean temperatures continue to warm, they will alter the entire globe. But there is hope; we can preserve the polar bear's home by reducing the amount of carbon dioxide (CO₂) in our atmosphere.

TEACHER PREP NOTES

This lesson contains two activities and will take 1-2 hours. Print the **Action Plan Template** handout (pg. 22) (for individual or small group work). This lesson assumes an understanding of how humans impact the earth. The lesson examines conservation actions that can produce a sustainable lifestyle. Conservation behaviors are the first step in creating a stewardship ethic, where every decision is tested against core values.

BACKGROUND INFORMATION

The uncertainty in climate science doesn't revolve around the physics of a warming world; rather, it concerns the timing of future warming and possible effects.

A recent study by Dr. Steven C. Amstrup and a team of scientists revealed a linear relationship between sea-ice coverage and global temperatures. The higher temperatures rose, the more sea ice disappeared. And the more sea ice disappeared, the less polar bear habitat was preserved. This means that saving polar bears and other arctic species is all about reducing temperature rise.

To preserve the climate on Earth in a state similar to the one in which humans have flourished, the science is clear that we must dramatically reduce our greenhouse

gas rise. There are long- and short-term answers to how to mitigate CO₂ levels in the atmosphere. Energy savings, as a class of conservation behaviors, are the most effective way for individuals to decrease their carbon footprints. Actions related to home efficiency and transportation can be accomplished by individuals at low—or sometimes no—cost and can save money at the same time.

Each action has a consequence—it either supports sustainability or is non-sustainable. Each decision counts and each can and bottle counts. Did you know that recycling one aluminum can saves enough energy to run a TV for three hours, the equivalent of a half-gallon of gasoline? Children have the power to make huge impacts; not only through their actions but through the influence they have on their families and friends. Actions set an example; they say far more than words. Every

action plan is personal—it's what makes sense to the individual and what that individual is capable of accomplishing that makes the difference. And it all adds up. Start small. Watch it grow.

GUIDING QUESTIONS:

- What does living sustainably really mean?
- What is community engagement?
- What are other words that we use to describe “action” taking place within a community?
- What do you value? Do your ethics (actions) always support your values?

MATERIALS:

Brainstorm Conservation Behaviors List (here's a start):

- Turn off lights when leaving the room
- Place anything that plugs in on a power strip to stop the flow of electricity when not in use

Key Words

Activism: Intentional efforts to promote environmental, social, or economic change.

Community: A social unit sharing common values and/or a group of organisms in a shared environment.

Adapted or Adaptation: A physical attribute of an organism that helps it survive in its habitat.

Sustainability: Long-term maintenance of responsibility within environmental, economic, and social dimensions.

Mitigation: Action to decrease the intensity and potential effects of a warming world.

Leadership: To lead and support others in the accomplishment of a common task.

Empowerment: The strength of individuals and communities.

Ethic: Actions/behaviors on a day-to-day basis.

Value: Something important to you personally.

Conservation: Ethics that maintain the health of the natural world.

Stewardship: An ethic that embodies responsible planning and management of resources.



Copyright © 2012 Warner Bros. Entertainment Inc. Photo: Shaun MacGillivray

Polar bears are uniquely adapted to the harsh Arctic environment. It may be one of the toughest places on Earth to survive but to a polar bear, it's home. And since the sun never sets during summer in the Arctic, bedtime is anytime.

- Ride your bike, walk, or take the bus to school
- Use minimal water with dish washing, brushing teeth, showering, etc.
- Wear a sweater versus turning up the heat
- **Action Plan Template** handout (one per student)

ACTIVITY ONE:

WHAT ARE CONSERVATION BEHAVIORS?

To Do

- 1 Review relevant vocabulary
- 2 Have students share their values (home, family, clean water, air, etc.).
- 3 Have students brainstorm day-to-day actions (ethics) related to their values.
- 4 In small groups, ask students to categorize different behaviors that are conservation ethics/actions or not. Have students explain their reasoning for categorization.
- 5 Have students present their lists and compare them with other groups. Depending upon the size of the class, you may do this activity two or three times combining groups, having them agree upon what is on the list or not until the whole class has an agreed-upon list.
- 6 Discussion: Why are identifying conservation behaviors important? What influence does choice have on living sustainably? What is a conservation or stewardship ethic?
- 7 30-Day Action Challenge! Have students brainstorm a list of choices they can make at school, at home, and in their community. For ideas, visit the Polar Bears International website www.polarbearsinternational.org/education/how-to-live-greener. Have students decide on one action to take as a class to be implemented for 30 days.

At the end of the 30 days, have students reflect on the impact their action made and how the action could be continued.

- 8 Have students complete journal entries or write media pieces to share in the school newsletter or students' social media.
- 9 Calculate students' greenhouse gas savings of their behaviors at www.epa.gov.

ACTIVITY TWO:

TAKING ACTION—COMMUNITY CHANGE

To Do

- 1 Lead a discussion about roles students can play in effecting change in their community.
 - a. What does it take? Motivating others, confidence in themselves and their abilities to effect change, a plan of action, and a way to measure the outcomes.
 - b. Who and what makes up a student's community? Is it a social definition or geographic definition?
 - c. Does it matter which definition is used in order to implement an action plan?
- 2 Using the **Action Plan Template**, have students create an Action Plan to be implemented for an extended period of time. Suggested themes for action projects include:
 - a. Energy saving
 - b. Closing the loop from recycling to buying recycling
 - c. Reforesting an area
 - d. Creating zero trash
- 3 To determine the effectiveness of the Action Plans, you can discuss the process, measure greenhouse gas reduction, or look back after nine months to determine if behaviors have been sustained.

Action Plan Template

Purpose: To create a “script” for your improvement effort and to support implementation of your plan.

Directions:

1. Using this form as a template, develop an Action Plan for each goal identified.
2. Distribute copies of each Action Plan to all group members.
3. Keep copies handy to review and update regularly. You may decide to adjust/develop new Action Plans as your inspiration changes.

Goal:

Results/Accomplishments:

Action Steps <i>What Will Be Done?</i>	Responsibilities <i>Who Will Do It?</i>	Timeline <i>By When? (Day/Month)</i>	Resources <i>Resources Available Resources Needed (financial, human, political & other)</i>	Potential Barriers <i>A. What individuals or organizations might resist? B. How?</i>	Communications Plan <i>Who is involved? What methods? How often?</i>
Step 1:			A. B.	A. B.	
Step 2:			A. B.	A. B.	
Step 3:			A. B.	A. B.	
Step 4:			A. B.	A. B.	
Step 5:			A. B.	A. B.	

Evidence Of Success (*How will you know that you are making progress? What are your benchmarks?*)

Evaluation Process (*How will you determine that your goal has been reached? What are your measures?*)

RESOURCES

BOOKS

Polar Bears: The Natural History of a Threatened Species
Ian Stirling, Fitzhenry & Whiteside, Markham, Ontario, 2011

Introduction to the World's Oceans
Keith Sverdrup and Virginia Armbrust, McGraw-Hill Science /Engineering/Math, 2008

WEBSITES

www.polarbearsinternational.org

Conservation through research, stewardship, and education

www.oneworldocean.org

A campaign to restore and protect the world's oceans.

www.alaskawild.org/take-action/educate/

Additional educational resources and classroom activities.

www.projectcaribou.net

An educator's guide to the wild caribou of North America that includes lesson plans, activities, and background information.

www.beingcaribou.com

On foot journey with the Porcupine Caribou herd including background, film and education resources.

polardiscovery.who.edu

Woods Hole Oceanographic Institution website. Education, research and information on ocean function, including focused information on polar areas.

www.iucnredlist.org

The IUCN Red List of Threatened Species™ is widely recognized as the most comprehensive, objective global approach for evaluating the conservation status of plant and animal species. This website can be used to find information on species worldwide, including in your home habitat.

www.windows2universe.org

Resources for teachers with an earth and space science focus, also including related humanities topics.

www.epa.gov

Includes educational resources for parents, students and teachers as well as up to date information on environmental issues across the U.S.

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Learn more about the film *TO THE ARCTIC* at

www.imax.com/tothearctic

Learn more about the film companion book *To The Arctic*

at www.welcometotheartctic.org

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"TO THE ARCTIC" A ONE WORLD ONE OCEAN PRESENTATION NARRATED BY MERYL STREEP MUSICAL SCORE BY STEVE WOOD SONGS BY PAUL MCCARTNEY
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www.imax.com/tothearctic



To THE ARCTIC Curriculum Guide

National Education Standards Alignment Charts

National Science Education Standards Alignment chart	A. Science as Inquiry	B. Physical Science	C. Life Science	D. Earth & Space Science	E. Science & Technology	F. Science in Personal & Social Perspectives	G. History & Nature of Science
1. Top of the World				X		X	
2. Arctic Biodiversity	X		X			X	
3. Caribou on the Move		X	X			X	
4. Mom and Me: Polar Bear Survival	X	X	X		X	X	X
5. Polar Bears in a Warming World	X	X	X	X		X	X
6. Taking Action!	X					X	

National Visual Arts Standards Alignment chart	1. Understanding and applying media techniques, and processes	2. Using knowledge of structures and functions	3. Choosing and evaluating a range of subject matter, symbols and ideas
1. Top of the World			X
2. Arctic Biodiversity	X	X	X
3. Caribou on the Move			
4. Mom and Me: Polar Bear Survival			
5. Polar Bears in a Warming World			
6. Taking Action!			

National English Language Arts Standards Alignment chart	4. Adjust their use of spoken, written, and visual language to communicate effectively with a variety of audiences and for different purposes	5. Employ a wide range of strategies as they write and use different process elements appropriately to communicate with different audiences for a variety of purposes	7. Conduct research on issues and interests by generating ideas and questions, and by posing problems. Gather, evaluate, and synthesize data from a variety of sources to communicate their discoveries in ways that suit their purposes and audience.	8. Use a variety of technological and informational resources to gather and synthesize information and to create and communicate knowledge.
1. Top of the World			X	
2. Arctic Biodiversity	X			X
3. Caribou on the Move		X	X	
4. Mom and Me: Polar Bear Survival			X	
5. Polar Bears in a Warming World			X	
6. Taking Action!	X	X	X	X

National Math Standards Alignment chart	1. Problem Solving	2. Communication	3. Reasoning	4. Connections	5. Patterns and Functions
1. Top of the World				X	
2. Arctic Biodiversity					
3. Caribou on the Move	X				
4. Mom and Me: Polar Bear Survival	X	X	X	X	X
5. Polar Bears in a Warming World	X			X	X
6. Taking Action!					

National Social Studies Standards Alignment chart	1. Culture	2. Time, continuity and change	3. People, places and environments	4. Individuals, groups and institutions	6. Power, authority, and governance	7. Production, distribution and consumption	8. Science, technology, and society	9. Global Connections
1. Top of the World	X							X
2. Arctic Biodiversity	X	X	X		X			X
3. Caribou on the Move	X	X	X			X	X	X
4. Mom and Me: Polar Bear Survival		X					X	X
5. Polar Bears in a Warming World		X	X	X	X	X	X	X
6. Taking Action!		X	X	X		X		X

National Geography Standards Alignment chart	1. The world in spatial terms	2. Places and regions	3. Physical systems	4. Human systems	5. Environment and society	6. The uses of geography
1. Top of the World	X	X		X		
2. Arctic Biodiversity		X	X		X	
3. Caribou on the Move	X	X	X	X	X	X
4. Mom and Me: Polar Bear Survival					X	X
5. Polar Bears in a Warming World		X	X	X	X	X
6. Taking Action!				X	X	